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IDENTIFIERS Alcohol Fuels; *Engine Modification; *Ignition Systems

ABSTRACT

This document contains 56 illustrations for use in an Illinois-developed competency-based course in ethanol spark ignition engine conversion. Each illustration is related to a specific competency in the course curriculum guide. Illustrations, which include photographs and line drawings, cover some of the following topics: carburetion, compression, ignition, testing and analysis, fuel comparisons, and fuel efficiency. (KC)

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R-31-33-D-0245-446

Illustrations For A Competency Based Curriculum Guide: Ethanol Spark Ignition Engine Conversion

Illinois State Board of Education

Adult Vocational and Technical Education

IL 82 13 23

ED251676

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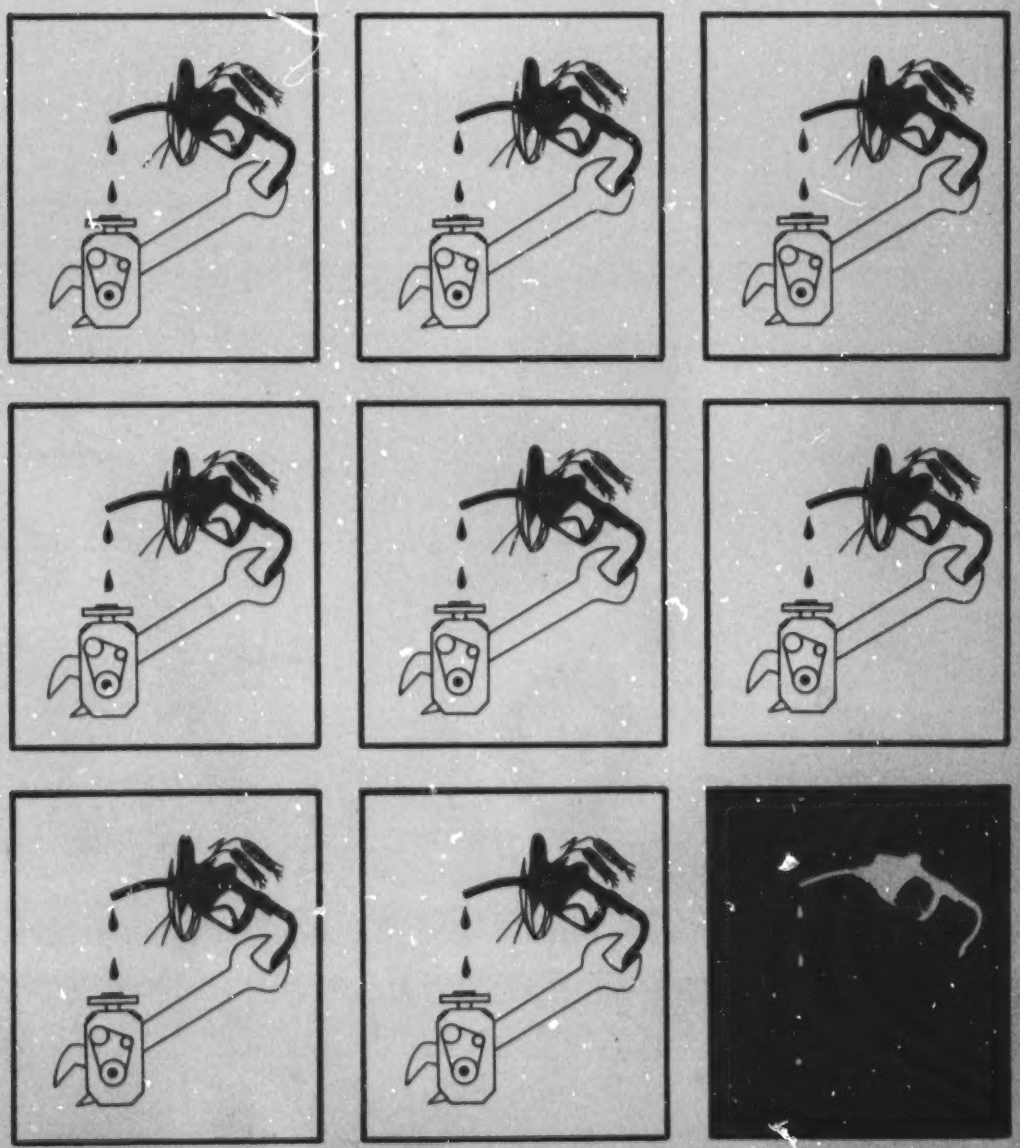

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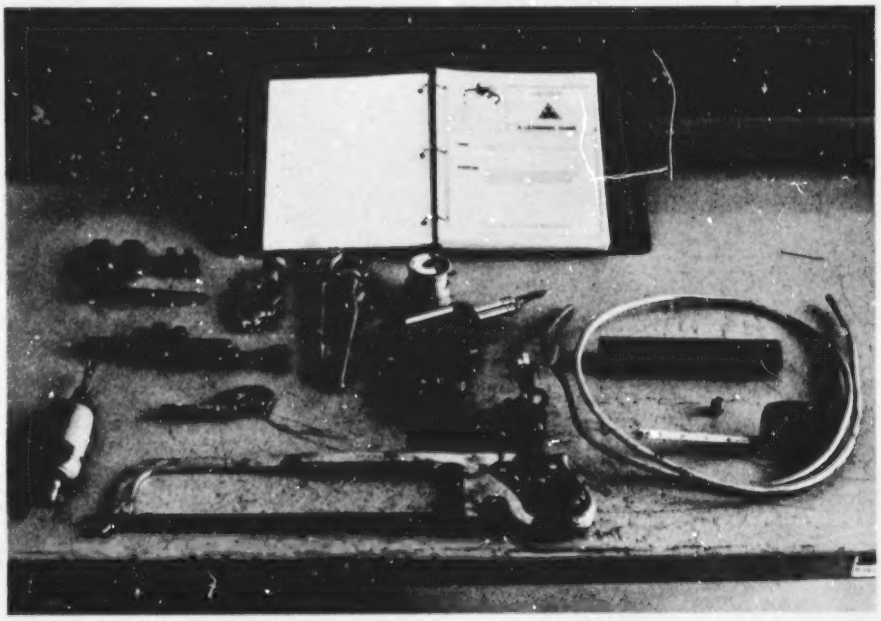
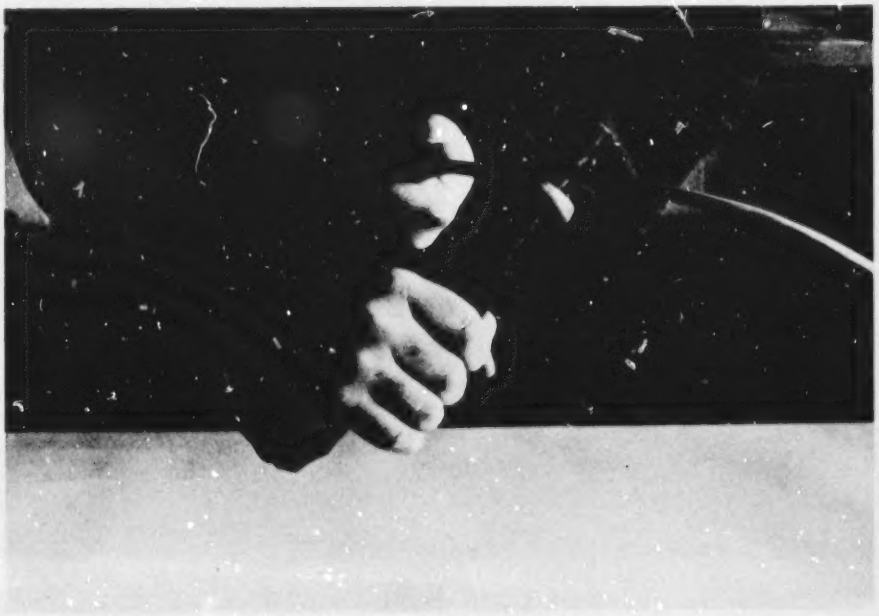


401-001-001
Constructing an
Ethanol Fuel Preheater
(Materials Required)

401-001-001
Constructing an
Ethanol Fuel
Preheater
(Operation #9)



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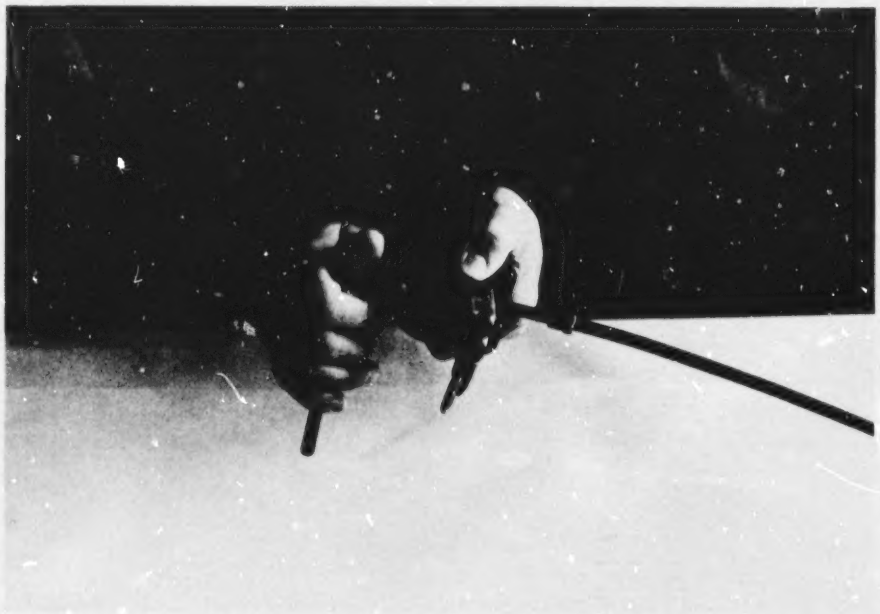
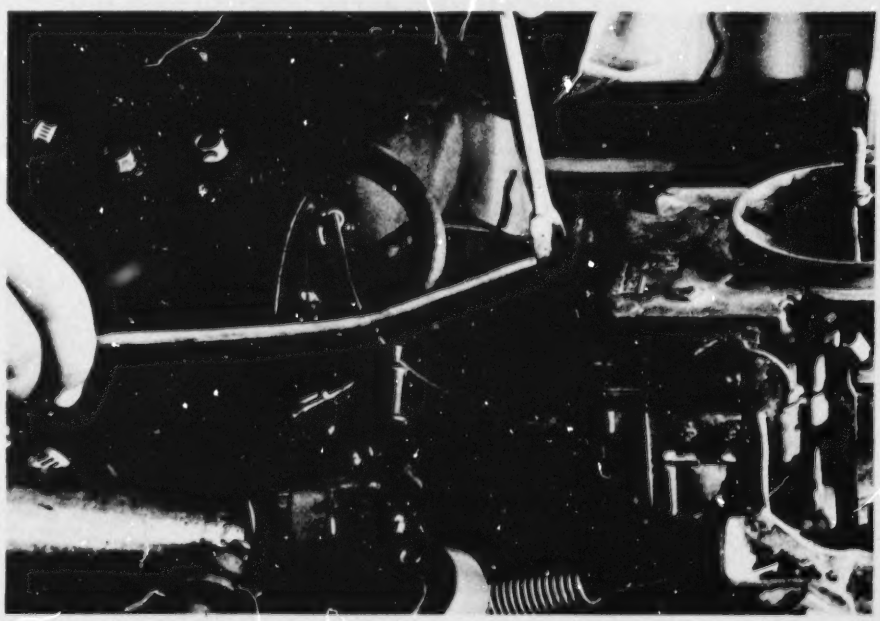


401-001-001
Constructing an
Ethanol Fuel
Preheater
(Operations #30-#33)

401-002-001
Installing an
Ethanol Fuel
Preheater
(Operation #9)



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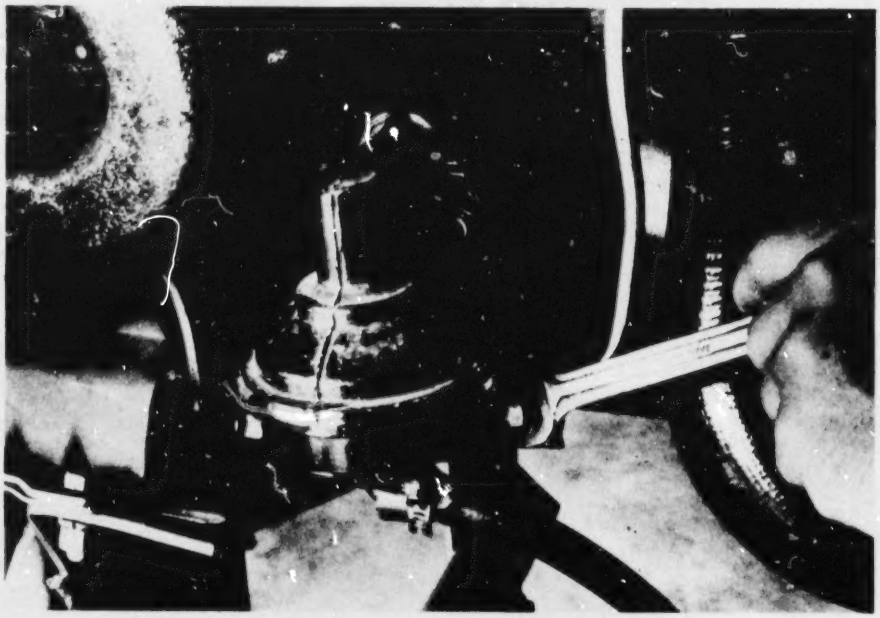
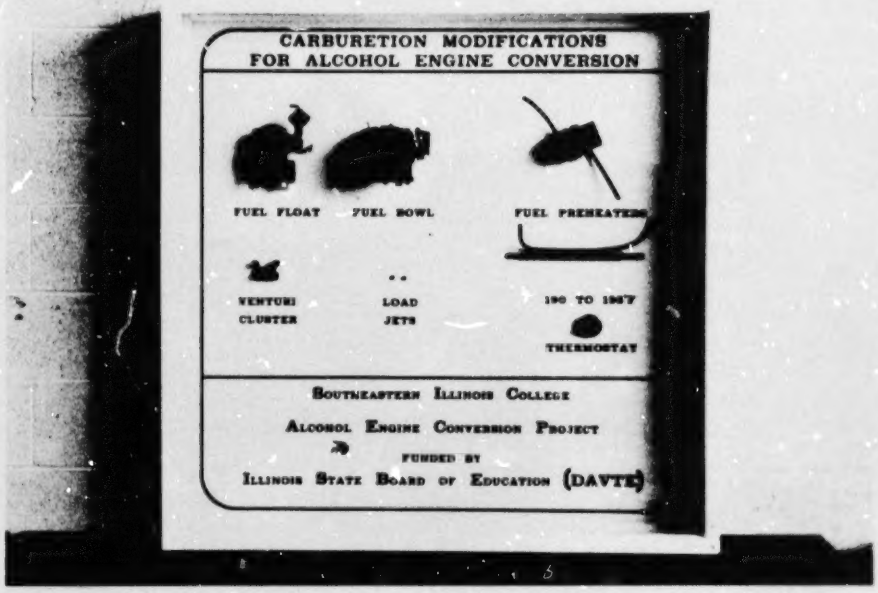


401-002-001
Installing an
Ethanol Fuel
Preheater
(Operation #10)

Task 400
Carburetion
Modifications
for Alcohol Engine
Conversion



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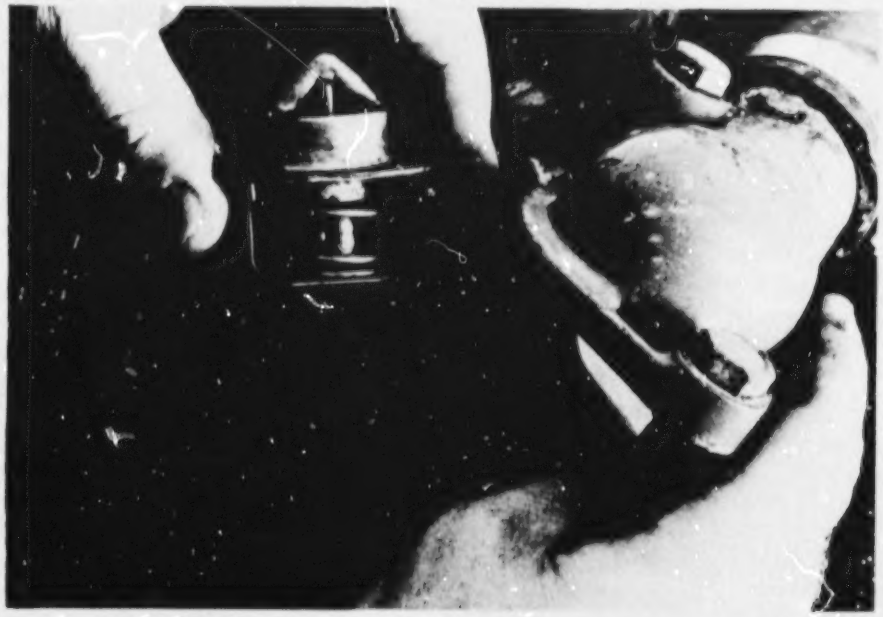
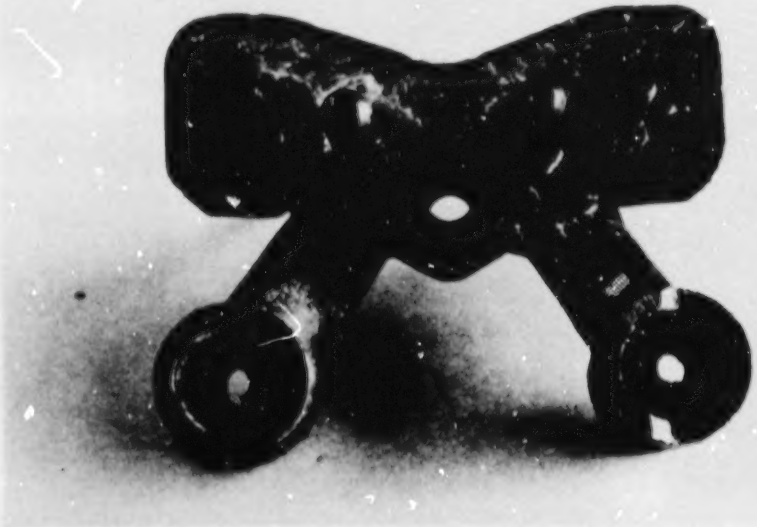


402-001-001
Installing a Thermostat in the Upper Radiator Hose (Operations #1-#8)

404-001-001
Measuring the Idle Circuit Tube Diameters (Operation #3)

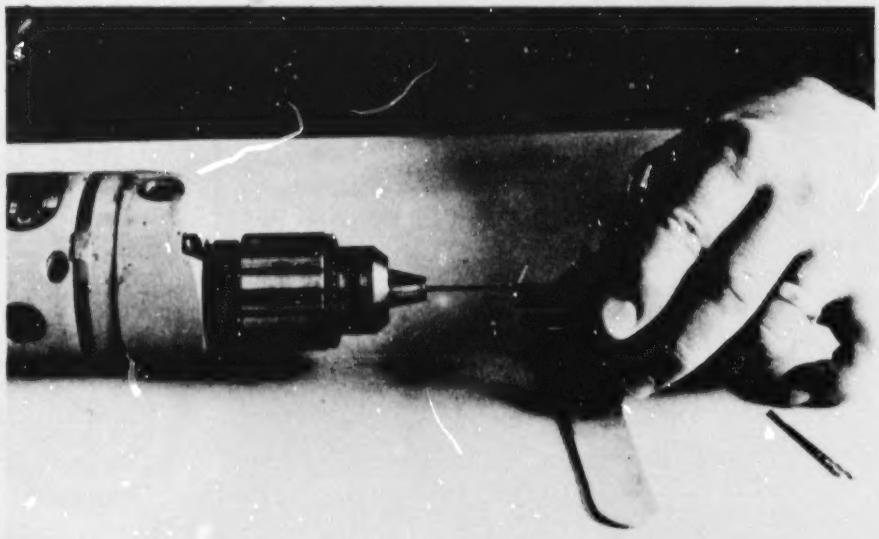


CARBURETION

404-001-001
Measuring the Idle Circuit Tube Diameters (Operations #4-#5)

404-002-001
Calculating the New Areas of the Idle Circuit Tubes (Operation #3)

CARBURETION



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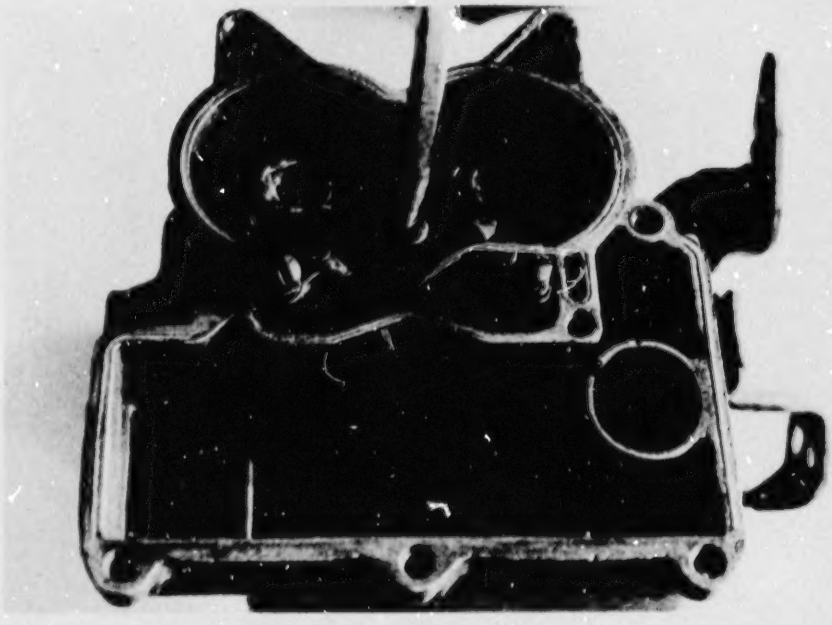
Drilling the Idle
Circuit Tubes
(Operation #4)

404-003-001
Drilling the Idle
Circuit Tubes
(Operation #6)



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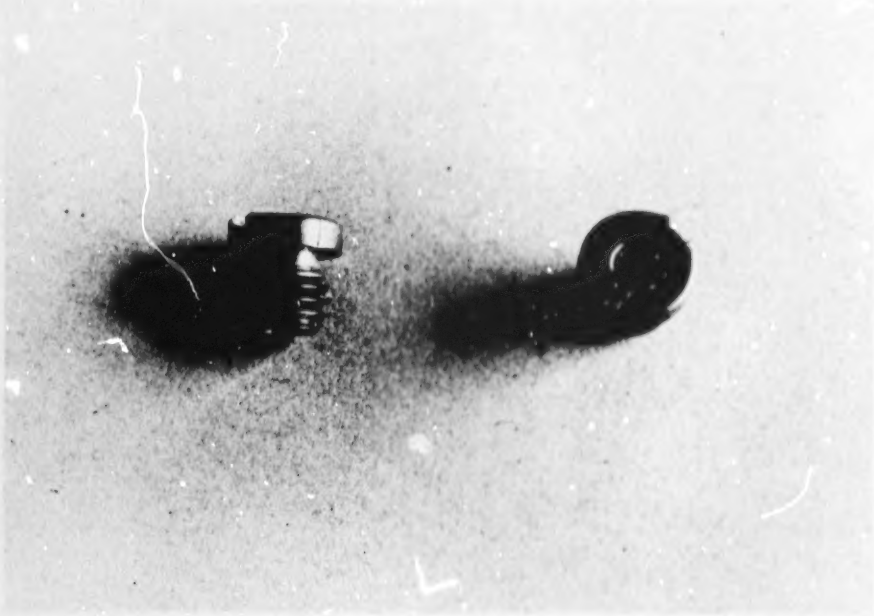
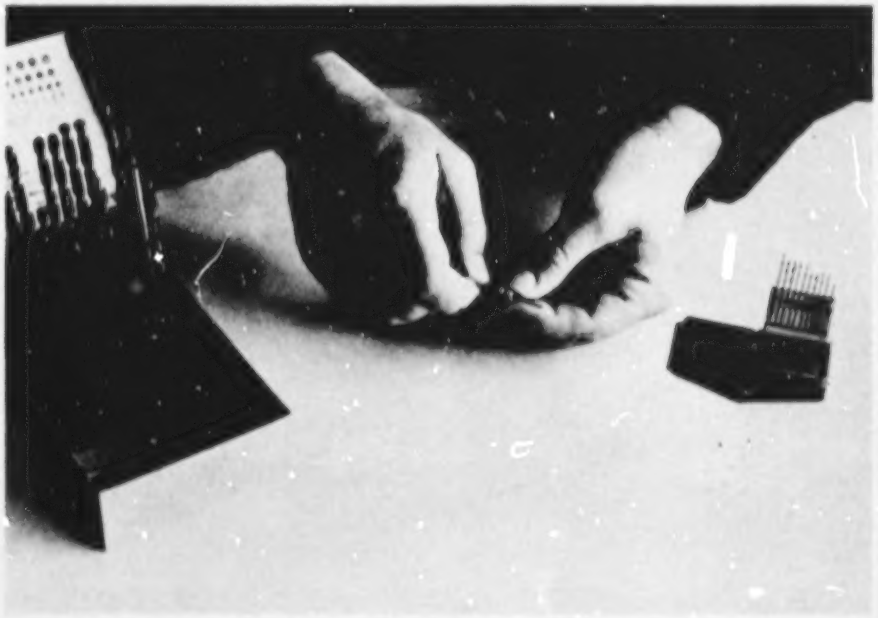


405-001-001
Measuring the
Main Jet Holes
(Operation #4)

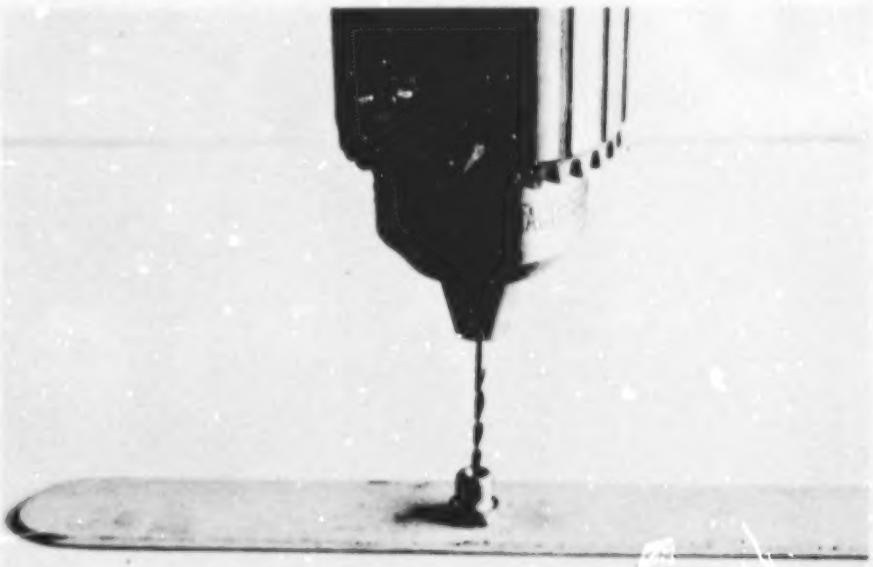
405-001-001
Measuring the
Main Jet Holes
(Operations #5-#6)



CARBURETION

405-002-001
Calculating the
New Areas of the
Main Jet Holes
(Operation #3)

405-003-001
Drilling the
Main Jet Holes
(Operation #4)



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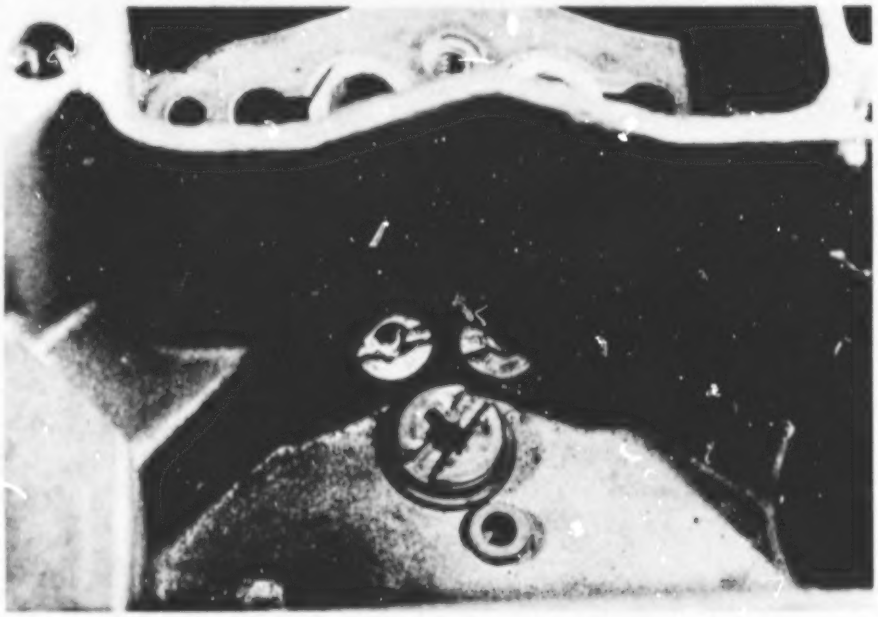


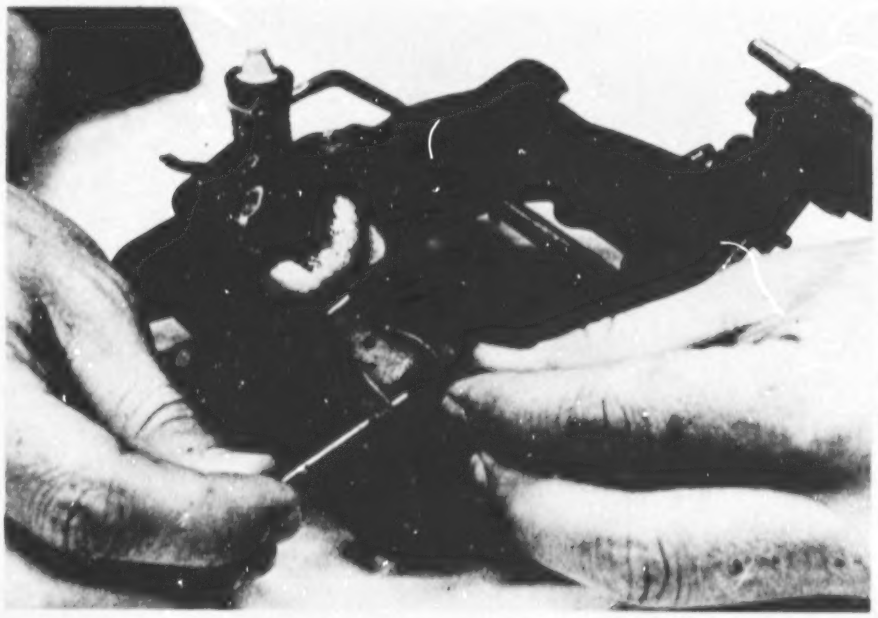
405-003-001
Drilling the
Main Jet Holes
(Operation #6)

406-002-001
Increasing the
Weight of the
Float
(Materials Needed)

CARBURETION

406-002-001
Increasing the
Weight of the
Float
(Operation #3)

406-002-001
Increasing the
Weight of the
Float
(Operation #6)



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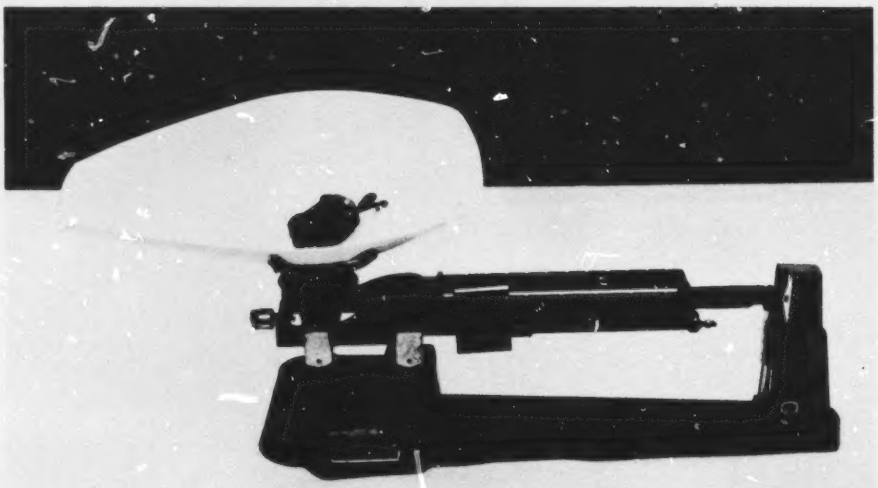
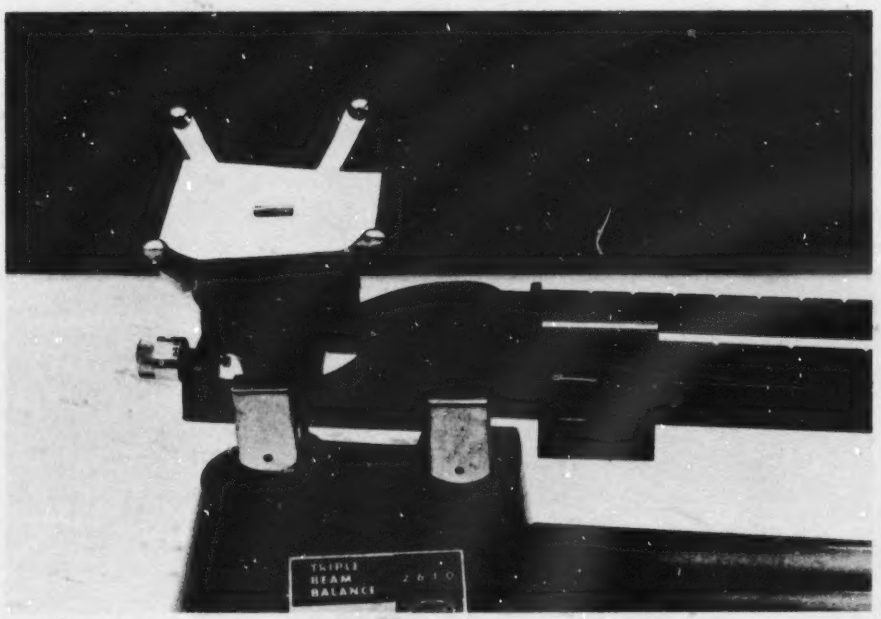


406-002-001
Increasing the
Weight of the
Float
(Operation #8)

406-002-001
Increasing the
Weight of the
Float
(Operation #10)



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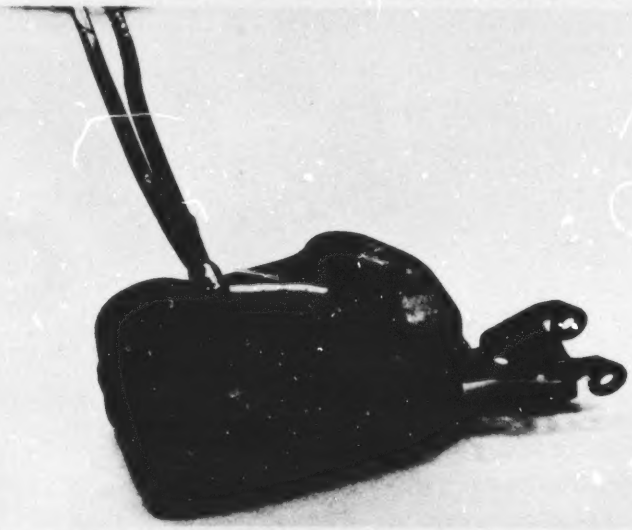
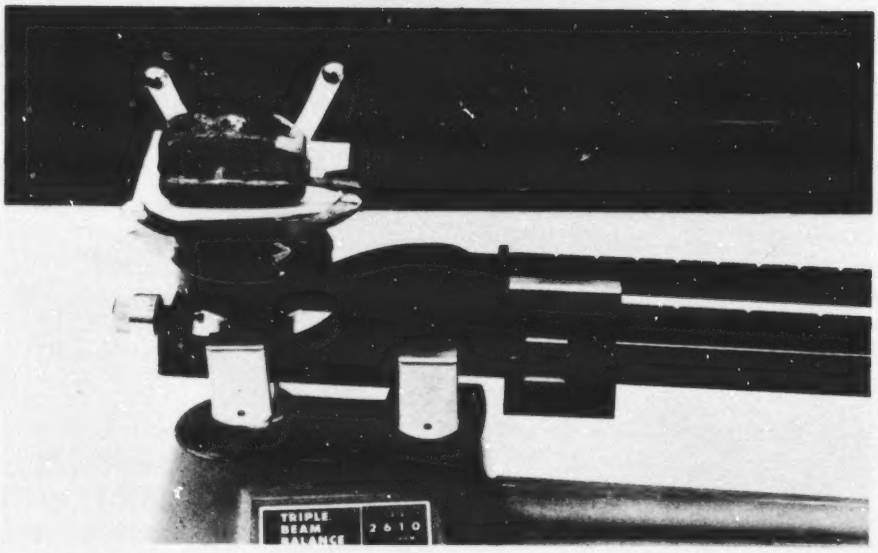
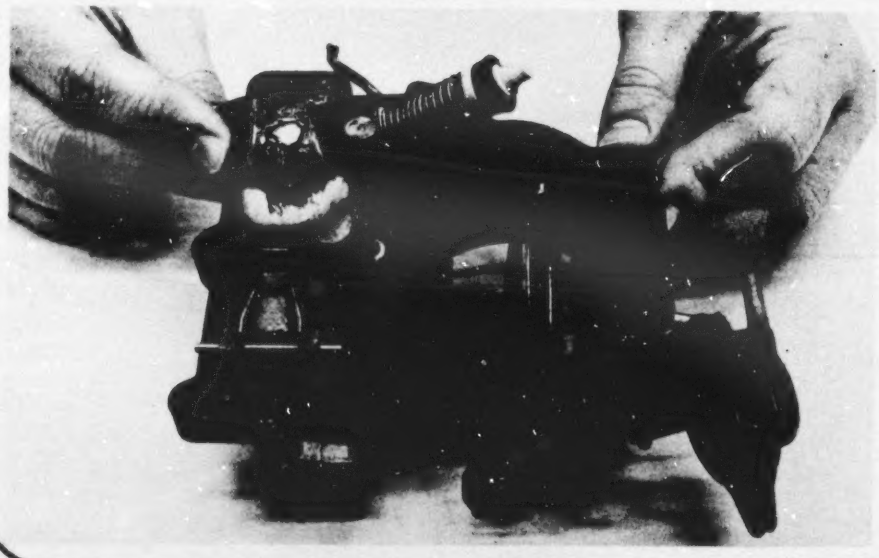


406-002-001
Increasing the
Weight of the
Float
(Operation #12)

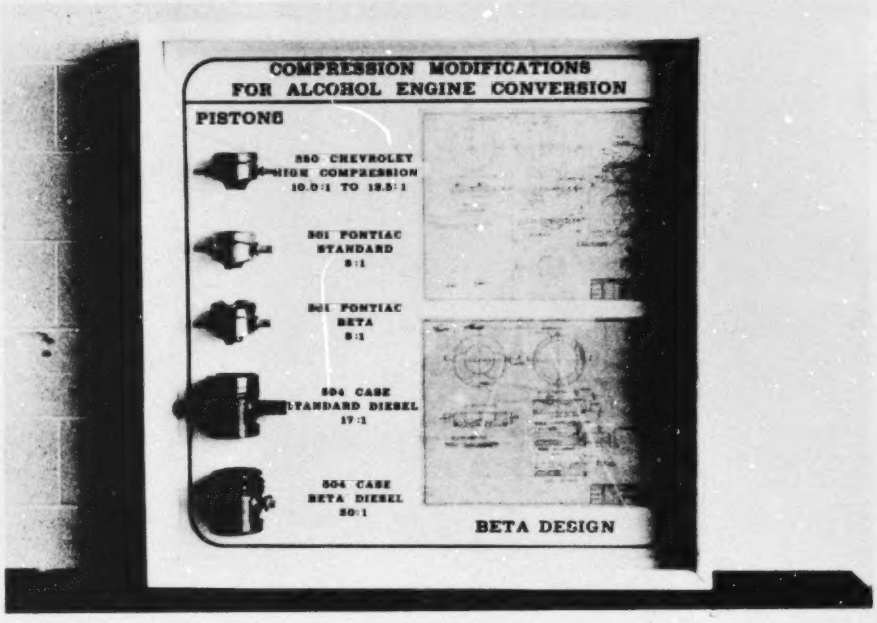


406-002-001
Increasing the
Weight of the
Float
(Operation #14)



406-002-001
Increasing the
Weight of the
Float
(Operation #16)

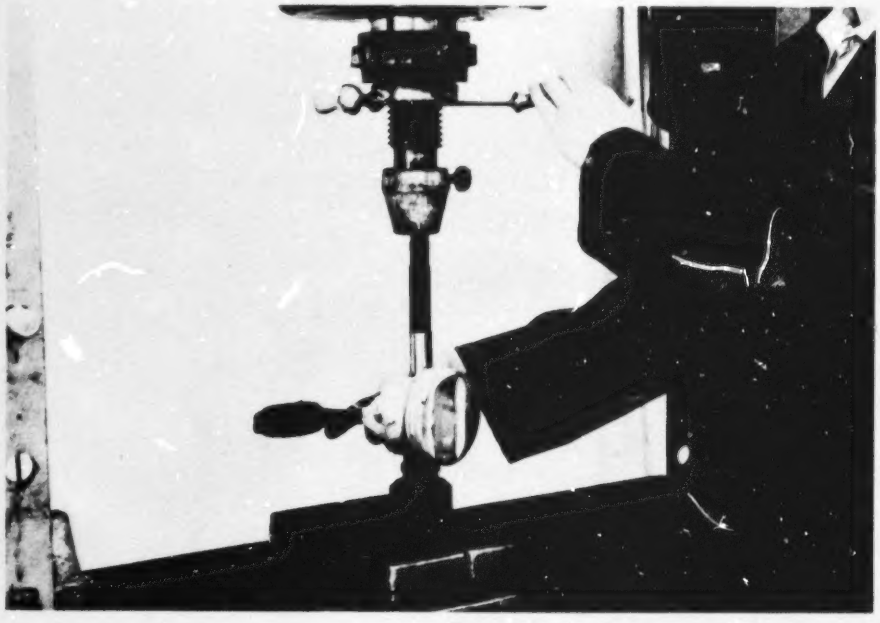
COMPRESSION



Task 500
Compression
Modifications
for Alcohol Engine
Conversion

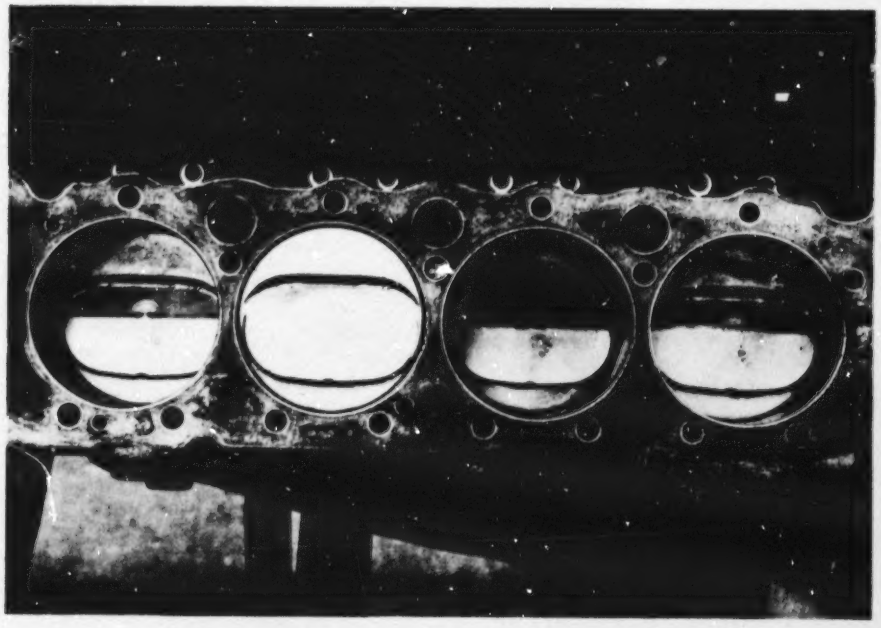
500-001-002
Installing High
Compression
Ratio Pistons
(Operation #3)

COMPRESSION

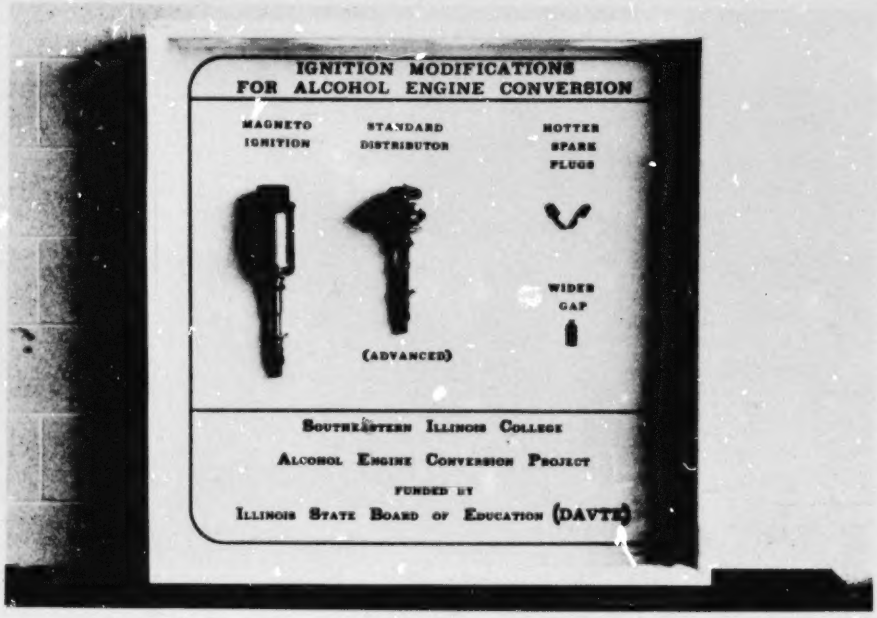


500-001-002
Installing High
Compression
Ratio Pistons
(Operation #9)

500-001-002
Installing High
Compression
Ratio Pistons
(Operation #13)



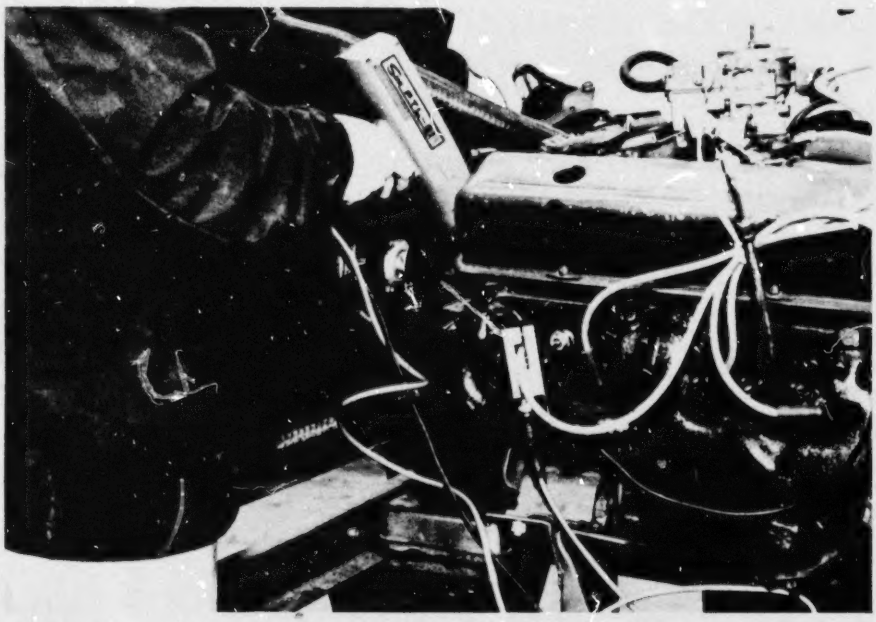
IGNITION



Task 600
Ignition
Modifications
for Alcohol Engine
Conversion

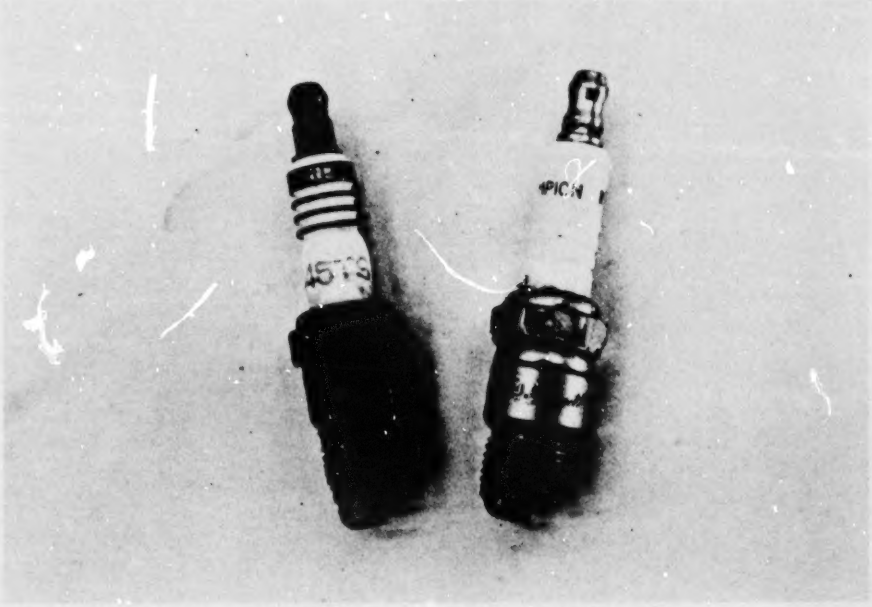
601-001-001
Advancing the
Initial Timing of
a Distributor
(Operation #2)

IGNITION

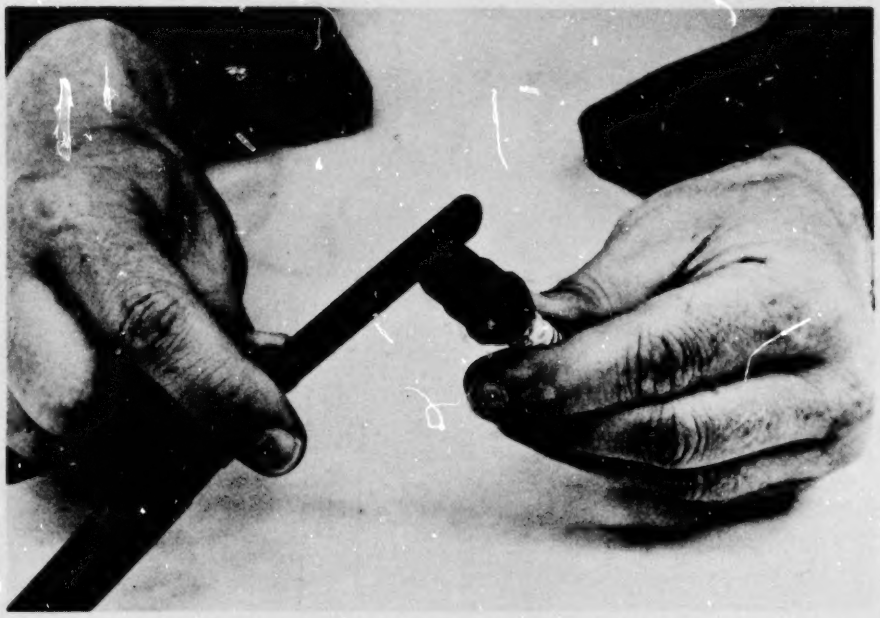


601-001-001
Advancing the Initial Timing of a Distributor (Operation #4)

602-001-001
Selecting Higher Heat Range Spark Plugs (Operation #4)

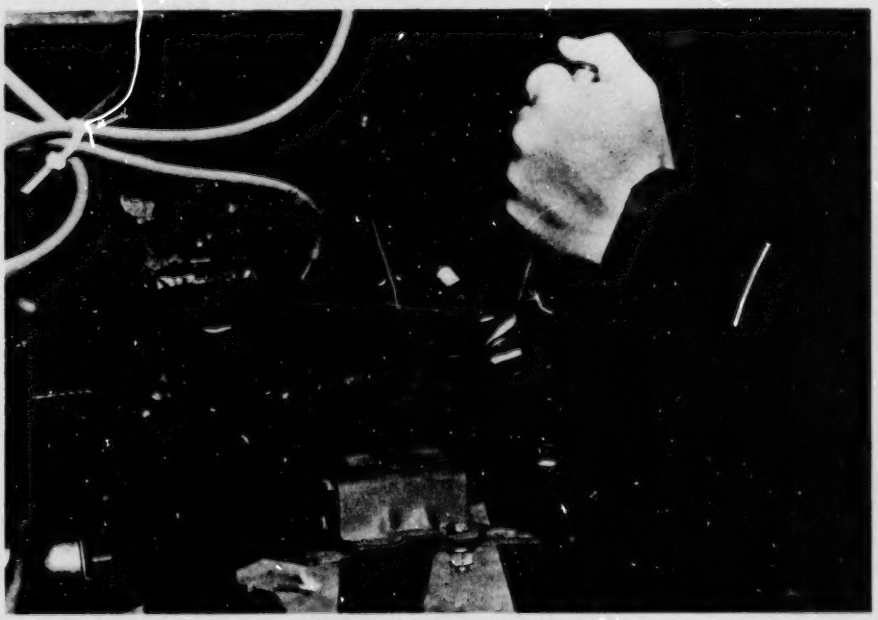


IGNITION

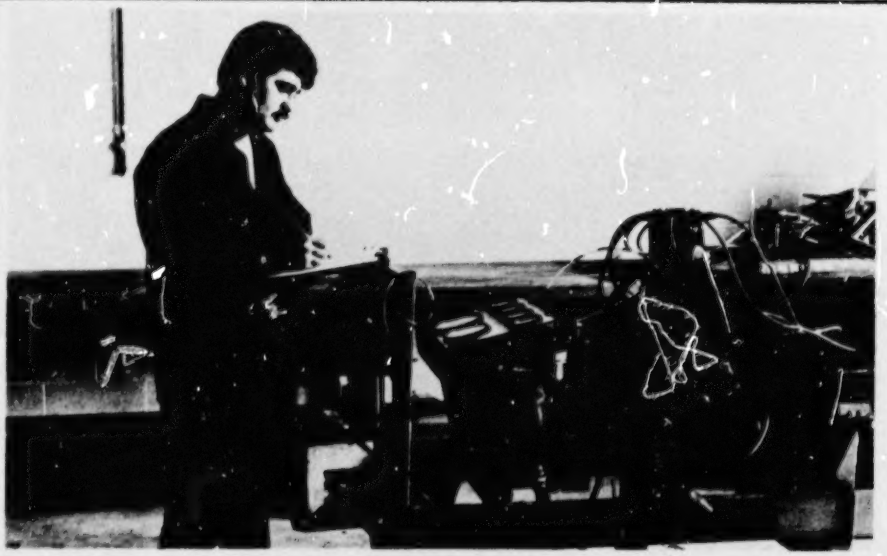


602-002-001
Gapping Higher Heat Range Spark Plugs (Operation #3)

602-003-001
Installing Higher Heat Range Spark Plugs (Operation #2)



TESTING AND ANALYSIS



Task 800
Engine Dynamometer

Task 800
Exhaust
Performance
Analyzer

Task 800
Electronic
Engine Tester

200-001-001

TABLE I FUEL COMPARISONS

THERMAL PROPERTIES	GASOLINE	ETHANOL
LOWER HEATING VALUE BTU/LB	18,900	11,500
HIGHER HEATING VALUE BTU/LB AT 68°F	20,260	12,800
HEAT OF VAPORIZATION BTU/GAL	900	3,378
OCTANE RATING RESEARCH	91 - 105	106 - 108
FLAMMABILITY LIMITS % BY VOL IN AIR	1.4 - 7.6	4.3 - 19.0
AUTOIGNITION TEMP °F	430 - 500	685
FLASH POINT °F	-50	70

TOLERANCES (EXCEPT AS NOTED)	REVISIONS NO.	DATE	BY
DECIMAL ±	1		
	2		
FRACTIONAL ±	3		
	4		
ANGULAR ±	5		

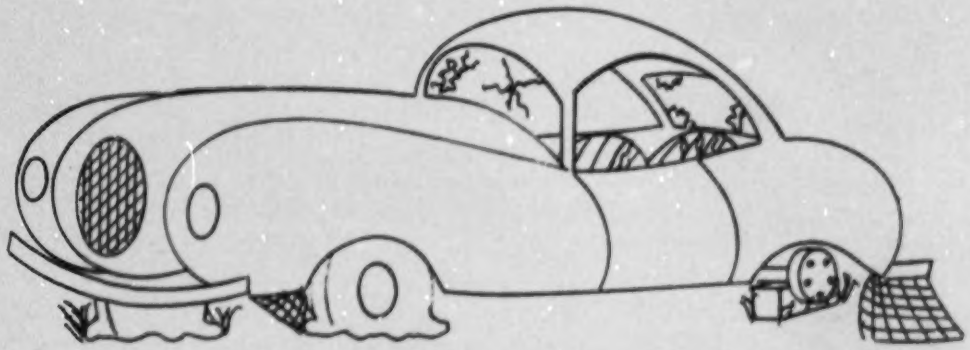
SOUTHEASTERN ILLINOIS COLLEGE

DRAWN BY	SCALE	MATERIAL
D. Rutledge		
CHK'D	DATE	DRAWING NO.
TRACED	APP'D	

200-003-002

PETROLEUM OUTLOOK

WORLD RESERVES	YEARS SUPPLY AT GROWTH RATE			
	0%	1%	3%	5%
PROVEN 3,480 QUADS	26	23	19	17
ULTIMATE 9,540 QUADS	71	54	38	31



TOLERANCES (EXCEPT AS NOTED)	REVISIONS			SOUTHEASTERN ILL COLLEGE		
DECIMAL ±	NO.	DATE	BY			
FRACTIONAL ±	1					
ANGULAR ±	2					
	3			DRAWN BY D. Rutledge	SCALE	MATERIAL
	4			CHK'D	DATE	DRAWING NO.
	5			TRACED	APP'D	

POTENTIAL ETHANOL PRODUCTION FROM ILLINOIS RESOURCES

200-003-002

RESOURCE	TOTAL PRODUCTION	ETHANOL YIELD	POTENTIAL TOTAL YIELD
CORN	1,400 MIL.BU	2.6 GAL/BU	3,600 MILLION GALLONS
WHEAT	55.9 MIL.BU	2.6 GAL/BU	145.3 MILLION GALLONS
OATS	16.2 MIL.BU	1.0 GAL/BU	16.2 MILLION GALLONS
SORGHUM GRAIN	5 1 MIL.BU	2 6 GAL/BU	13.3 MILLION GALLONS
		TOTAL	3,774.8 MILLION GALLONS

THIS DOES NOT REPRESENT ALL POTENTIAL RESOURCES

TOLERANCES (EXCEPT AS NOTED)	REVISIONS			SOUTHEASTERN ILLINOIS COLLEGE		
DECIMAL ±	NO.	DATE	BY			
	1					
FRACTIONAL ±	2					
	3			DRAWN BY D. Rutledge	SCALE	MATERIAL
ANGULAR ±	4			CHK'D	DATE	DRAWING NO.
	5			TRACED	APP'D	

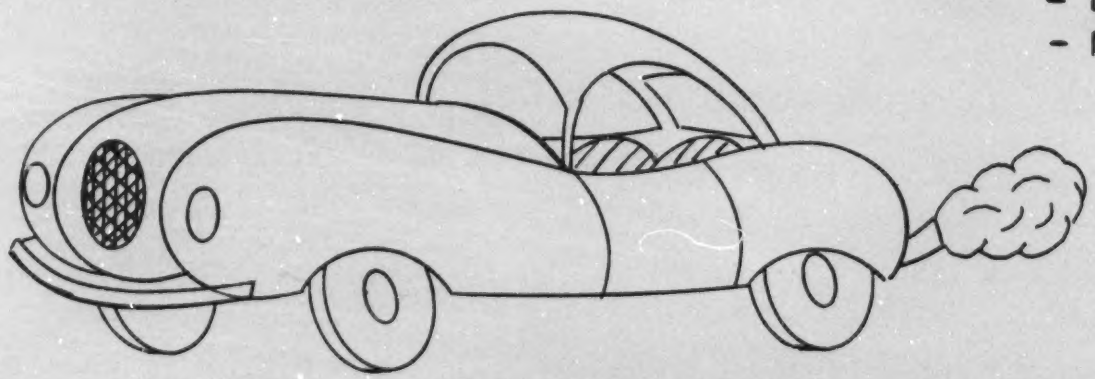
200-003-002

ADVANTAGES WITH ALCOHOL

ALCOHOL COOLER BURNING
FUEL ECONOMY EQUAL TO GASOLINE
ALCOHOL IS A RENEWABLE RESOURCE

- CLEANER BURNING
- FORMS NO CARBON
- LOWER POLLUTION
- NO BLACK SMOKE

LESS DAMAGE TO VALVES



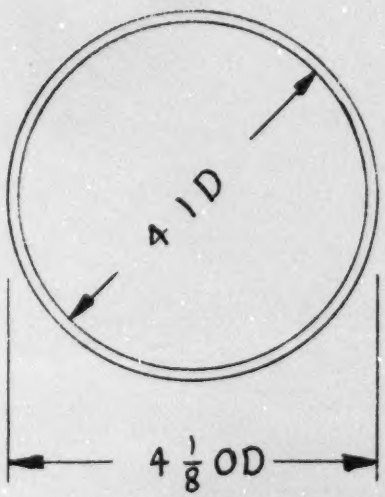
TOLERANCES (EXCEPT AS NOTED)	REVISIONS			SOUTHEASTERN ILL COLLEGE		
DECIMAL ±	NO.	DATE	BY			
	1					
FRACTIONAL ±	2					
	3			DRAWN BY D. Rutledge	SCALE	MATERIAL
ANGULAR ±	4			CHK'D	DATE	DRAWING NO.
	5			TRACED	APP'D	28

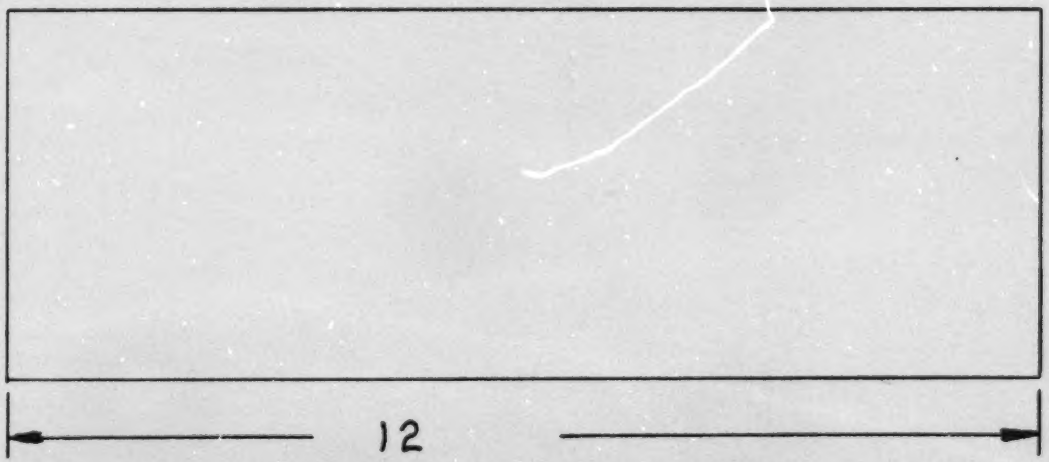
27

401-001-001

CONSTRUCTING PREHEATER ACTIVITY SHEET 401-001-001
READ STEP 1

MATERIAL NOTE:
COPPER PREFERRED FOR BETTER HEAT TRANSFERENCE

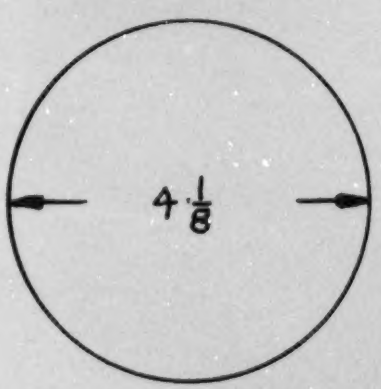


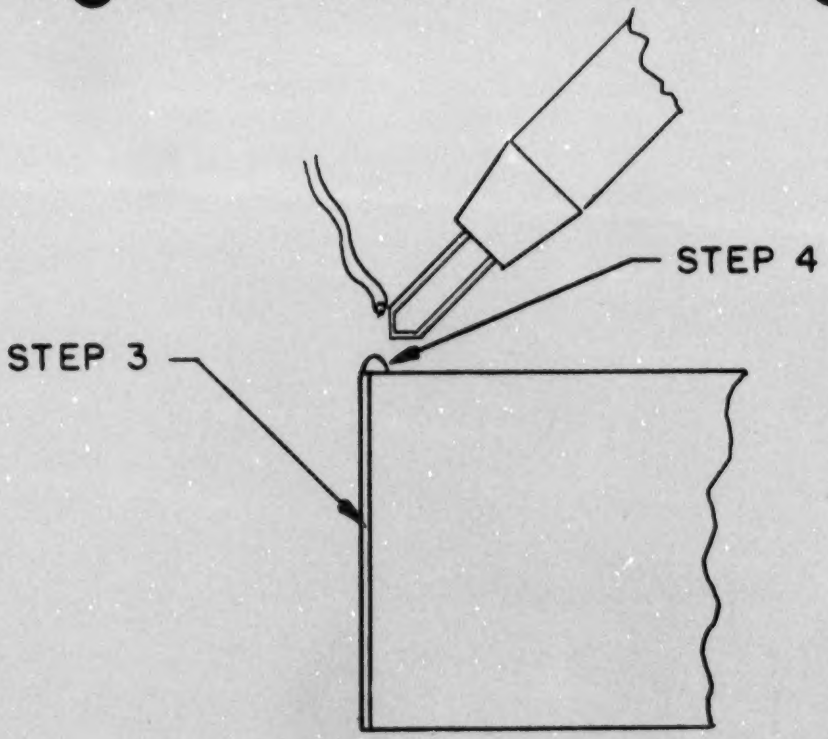


TOLERANCES (EXCEPT AS NOTED)	REVISIONS			SOUTHEASTERN ILL COLLEGE		
DECIMAL ±	NO.	DATE	BY	FUEL PREHEATER (PIPE)		
FRACTIONAL ±	1			DRAWN BY D. Rutledge	SCALE HALF	MATERIAL SEE NOTE
ANGULAR ±	2			CHK'D	DATE	DRAWING NO. DR-43082-1
	3			TRACED	APP'D	
	4					
	5					

401-001-001

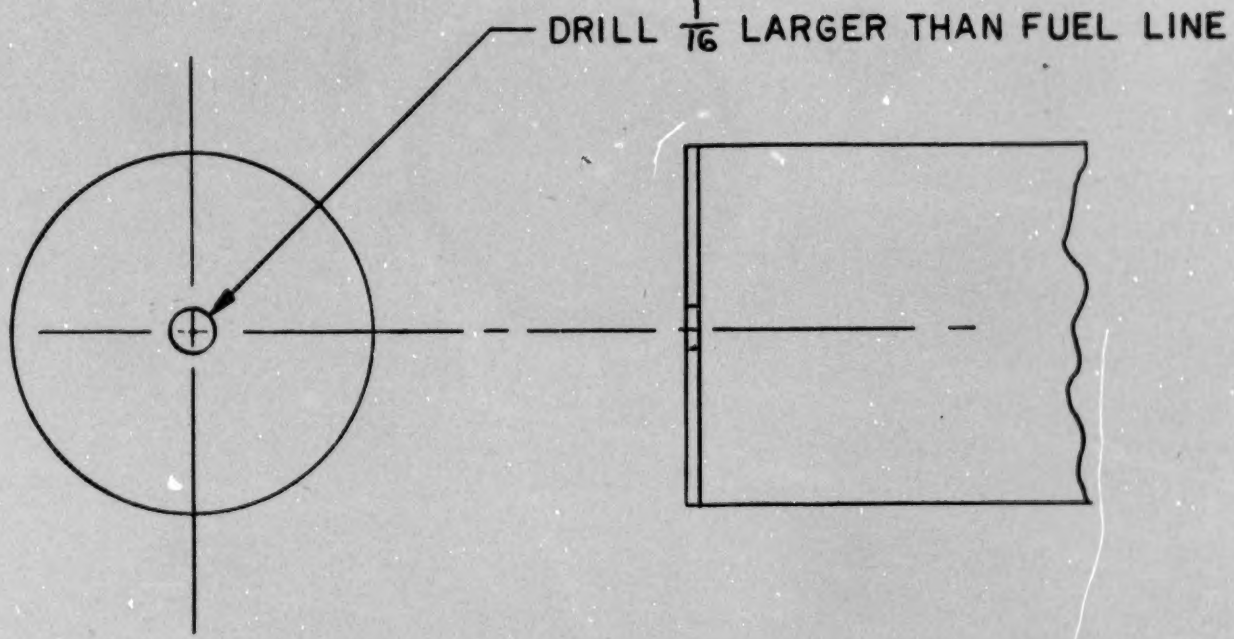
READ STEP 2





TOLERANCES (EXCEPT AS NOTED)	REVISIONS			SOUTHEASTERN ILL COLLEGE		
DECIMAL ±	NO.	DATE	BY	FUEL PREHEATER (END CAP)		
FRACTIONAL ±	1			DRAWN BY D. Rutledge	SCALE HALF	MATERIAL
ANGULAR ±	2			CHK'D	DATE	DRAWING NO. DR 43082-2
	3			TRACED	APP'D	
	4					
	5					

401-001-001
Step 7



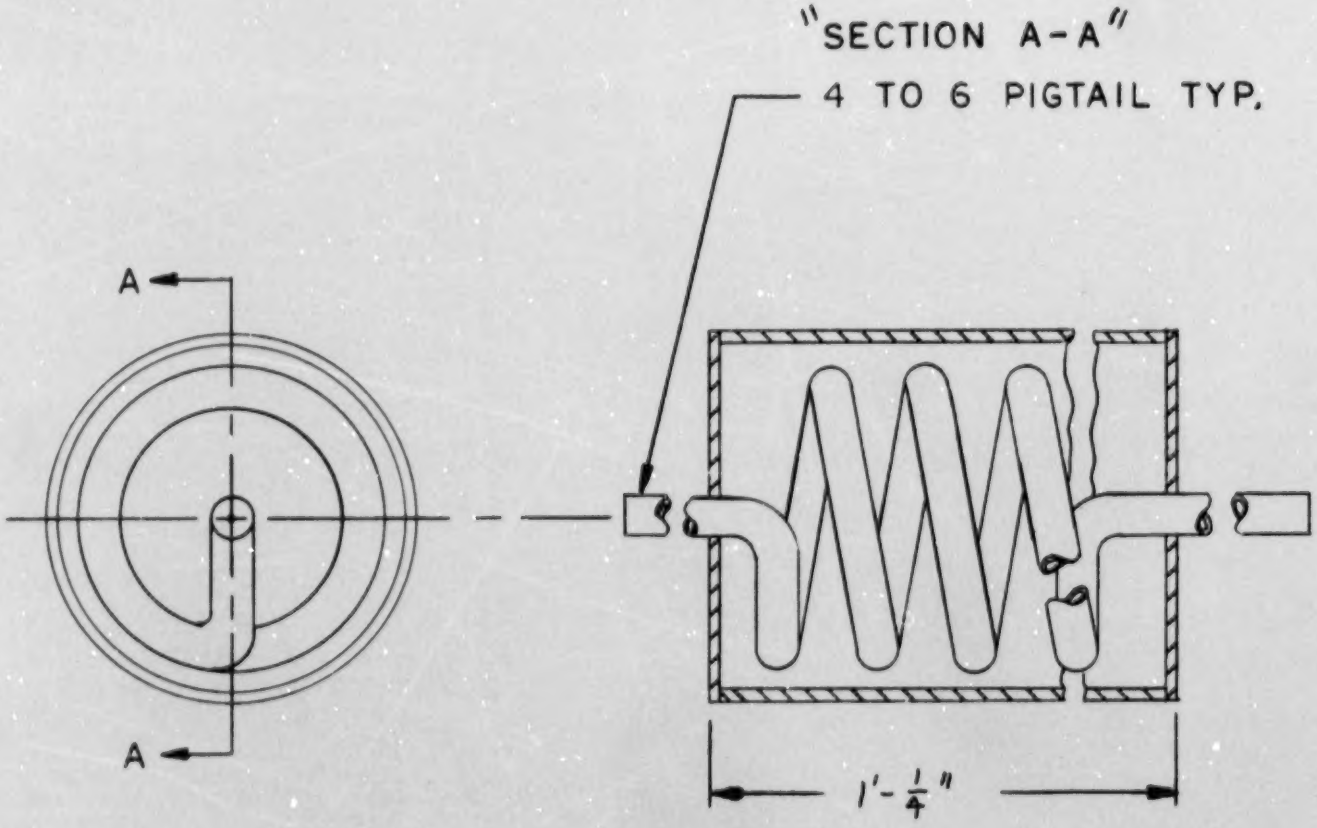
TOLERANCES (EXCEPT AS NOTED)	REVISIONS		
DECIMAL ±	NO.	DATE	BY
FRACTIONAL ±	1		
ANGULAR ±	2		
	3		
	4		
	5		

SOUTHEASTERN ILL COLLEGE

FUEL PREHEATER (DRILLING)

DRAWN BY	SCALE	MATERIAL
D. Rutledge	HALF	
CHK'D	DATE	DRAWING NO.
TRACED	APP'D	DR-43082-3

401-001-001



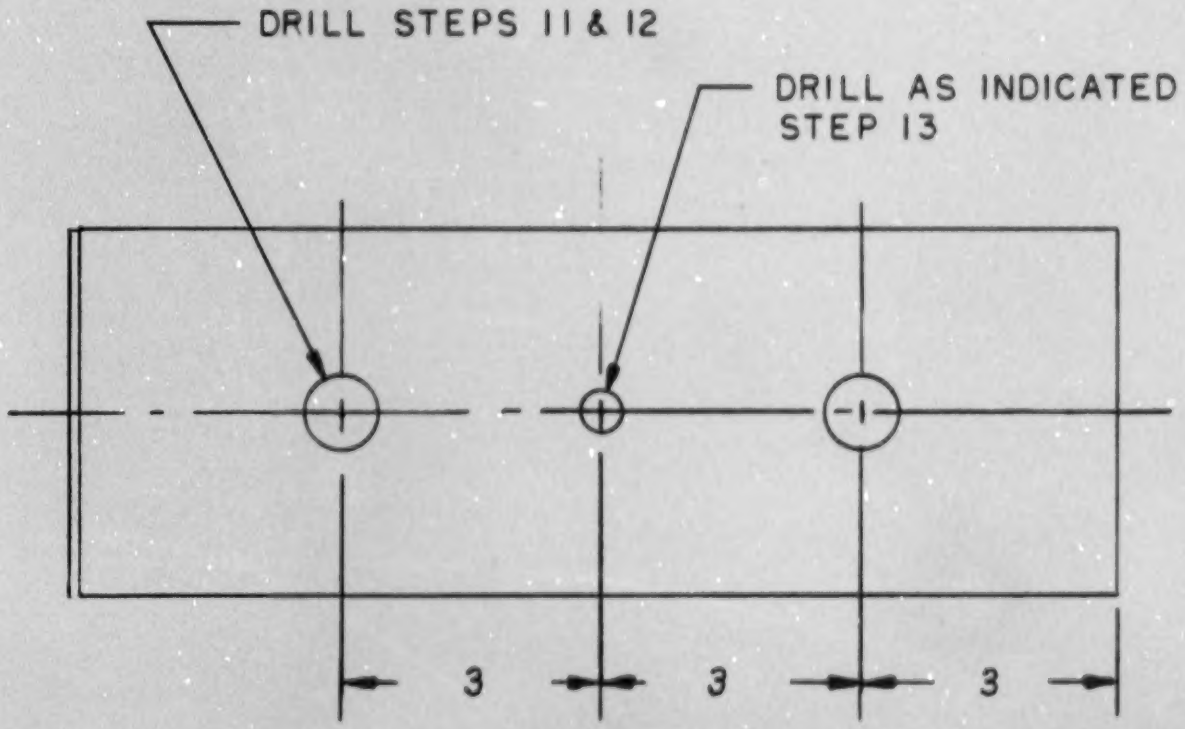
TOLERANCES (EXCEPT AS NOTED)	REVISIONS		
	NO.	DATE	BY
DECIMAL ±	1		
	2		
FRACTIONAL ±	3		
	4		
ANGULAR ±	5		

SOUTHEASTERN ILL COLLEGE

FUEL PREHEATER (COIL)

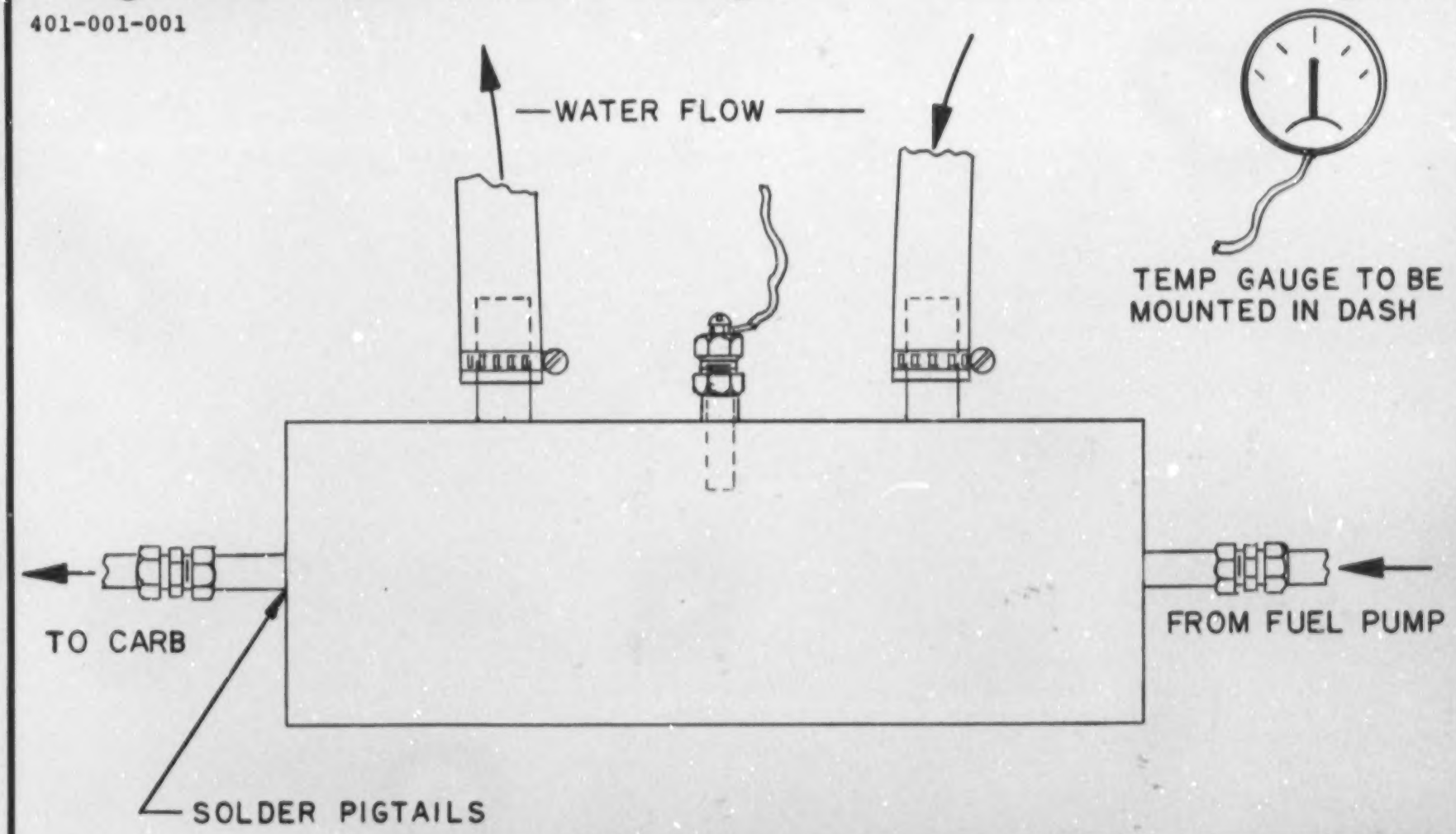
DRAWN BY	SCALE	MATERIAL
D. Rutledge	HALF	
CHK'D	DATE	DRAWING NO.
TRACED	APP'D	DR-5182-4

401-001-001



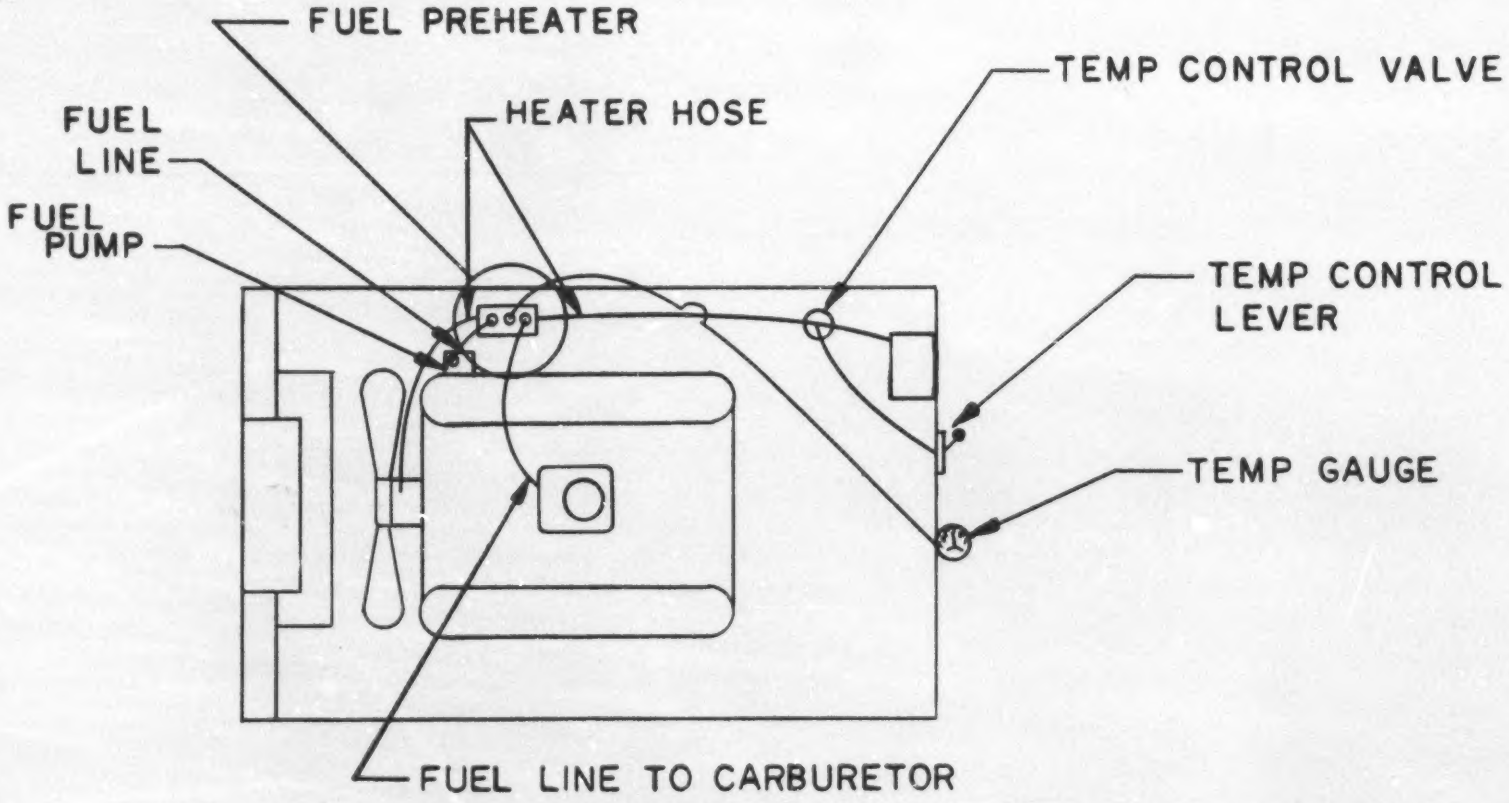
TOLERANCES (EXCEPT AS NOTED)	REVISIONS			SOUTHEASTERN ILL COLLEGE		
DECIMAL ±	NO.	DATE	BY	FUEL PREHEATER		
FRACTIONAL ±	1			DRAWN BY D. Rutledge	SCALE	MATERIAL
ANGULAR ±	2			CHK'D	DATE	DRAWING NO. DR-43082-5
	3			TRACED	APP'D	
	4					
	5					

401-001-001



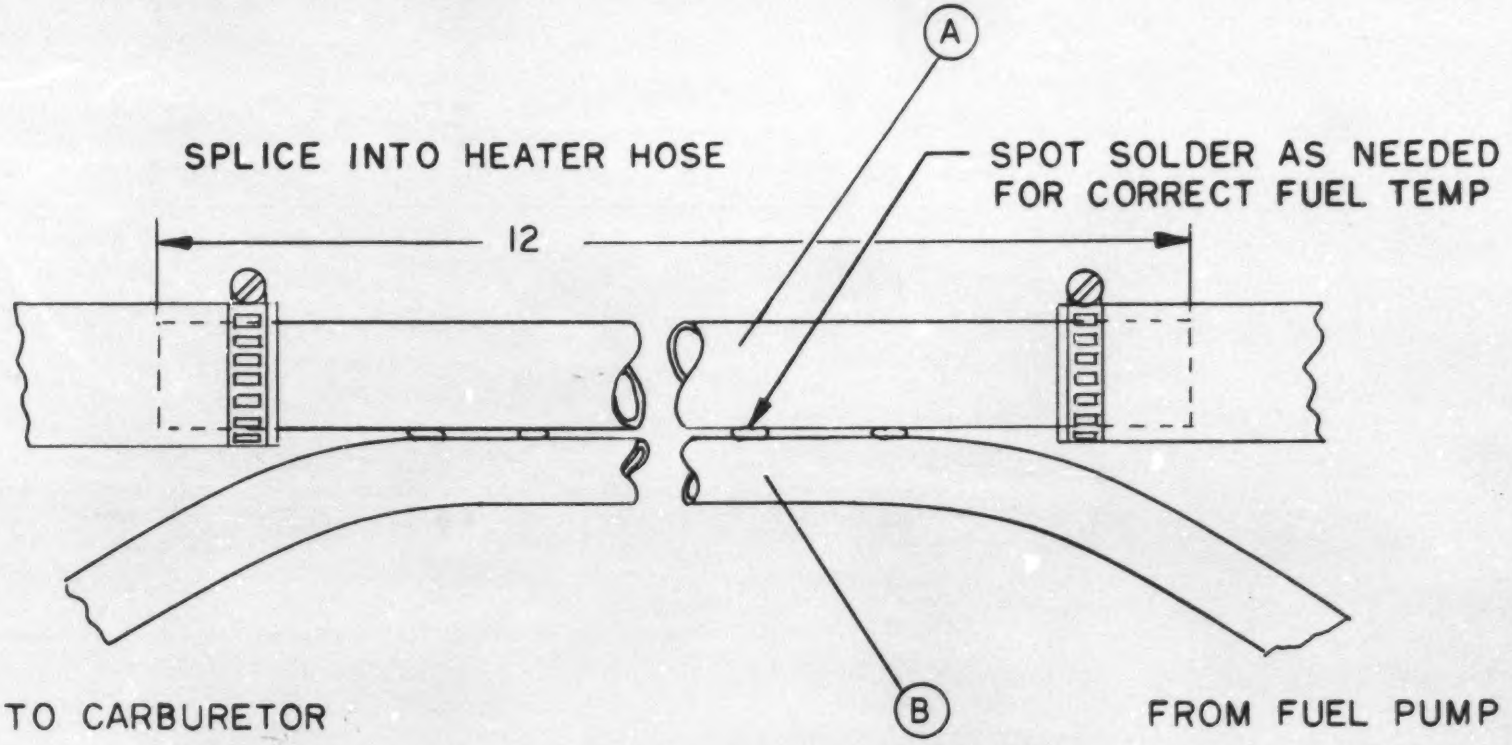
TOLERANCES (EXCEPT AS NOTED)	REVISIONS			SOUTHEASTERN ILL COLLEGE		
DECIMAL ±	NO.	DATE	BY	FUEL PREHEATER		
FRACTIONAL ±	1			DRAWN BY D. Rutledge	SCALE HALF	MATERIAL
ANGULAR ±	2			CHK'D	DATE	DRAWING NO. DR-51082-6
	3			TRACED	APP'D	
	4					
	5					

401-002-001



LOCATION SHOWN FOR REFERENCE ONLY

TOLERANCES (EXCEPT AS NOTED)	REVISIONS NO.	DATE	BY	SOUTHEASTERN ILL COLLEGE		
DECIMAL ±	1			FUEL PREHEATER		
FRACTIONAL ±	2			DRAWN BY D. Rutledge	SCALE	MATERIAL
ANGULAR ±	3			CHK'D	DATE	DRAWING NO. DR-52482-7
	4			TRACED	APP'D	
	5					



COPPER TUBING USED FOR
BETTER HEAT TRANSFERENCE

MATERIAL LIST		
	DESCRIPTION	SIZE
A	HEAT LINE	ID OF EXIST.
B	FUEL LINE	SAME AS ORIG.

43

TOLERANCES (EXCEPT AS NOTED)
DECIMAL ±
FRACTIONAL ±
ANGULAR ±

REVISIONS		
NO.	DATE	BY
1		
2		
3		
4		
5		

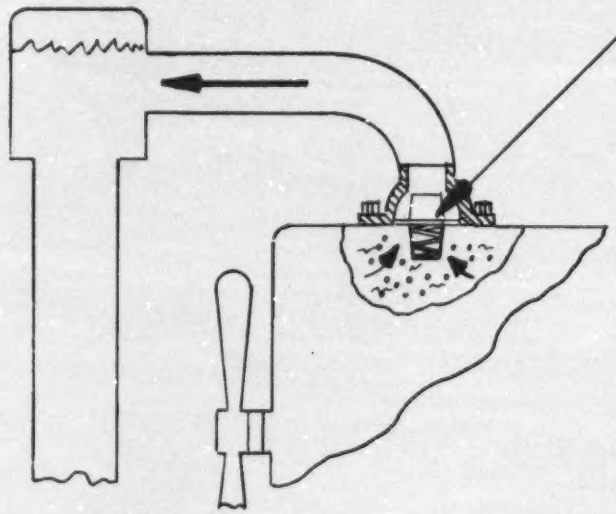
SOUTHEASTERN ILL COLLEGE

SIMPLE PREHEATER

DRAWN BY: D. Rutledge	SCALE	MATERIAL: SEE NOTE
CHK'D	DATE	DRAWING NO.: DR-52082-8
TRACED	APP'D	

44

402-001-001

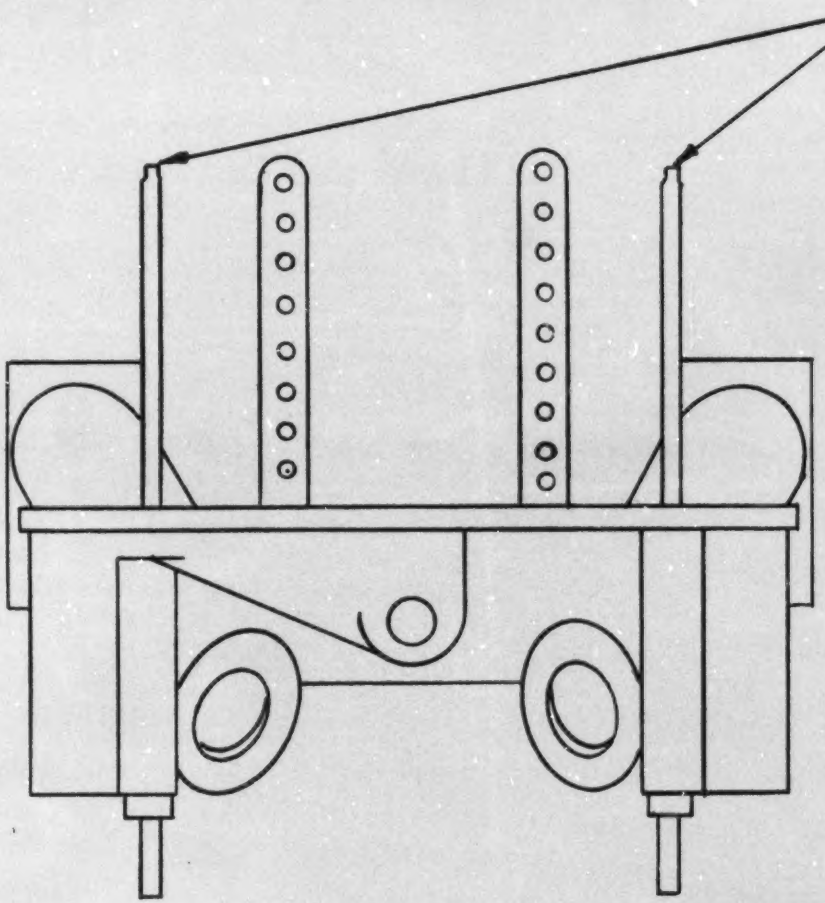


INSTALL 190° THERMOSTAT TO RAISE WATER TEMP FOR OPERATION OF FUEL PREHEATER

TOLERANCES (EXCEPT AS NOTED)	REVISIONS			SOUTHEASTERN ILL COLLEGE		
DECIMAL ±	NO.	DATE	BY	WATER TEMP CHANGE		
FRACTIONAL ±	1					
ANGULAR ±	2					
	3			DRAWN BY D. Rutledge	SCALE	MATERIAL
	4			CHK'D	DATE	DRAWING NO. 46
	5			TRACED	APP'D	

404-003-001

INCREASE IDLE TUBE ORIFICE
FROM .028 TO .040 BY AREA



VENTURI ASSEMBLY
1970 CHEVY C-10 P.U.
307 CID
ROCHESTER 2 BARREL

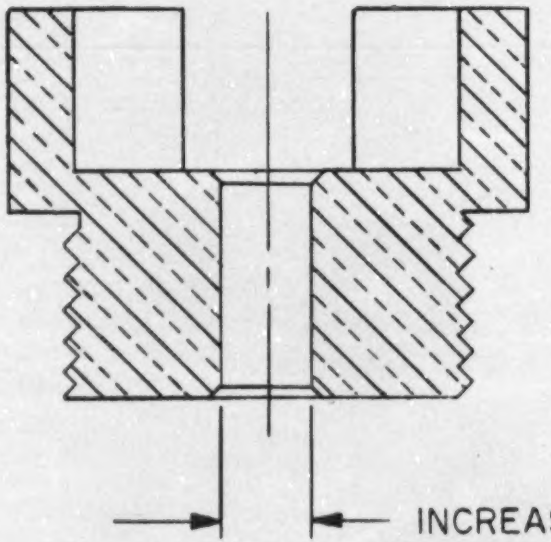
TOLERANCES (EXCEPT AS NOTED)	REVISIONS		
DECIMAL ±	NO.	DATE	BY
FRACTIONAL ±	1		
ANGULAR ±	2		
	3		
	4		
	5		

SOUTHEASTERN ILL COLLEGE

IDLE TUBE MODIFICATION

DRAWN BY	SCALE	MATERIAL
D. Rutledge		
CHK'D	DATE	DRAWING NO.
TRACED	APP'D	

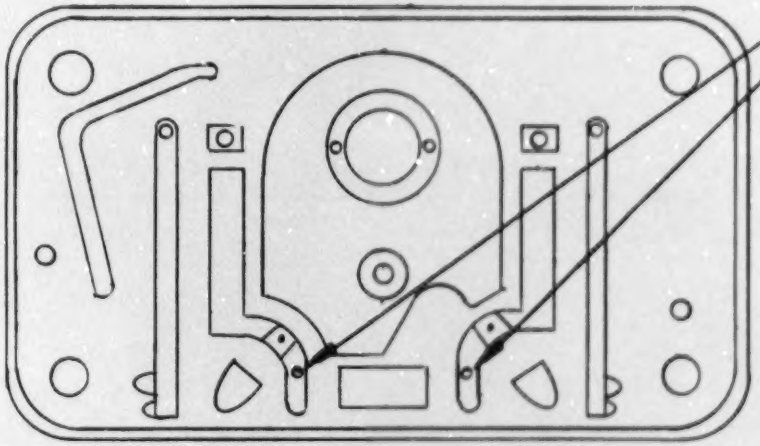
405-003-001



HOLLEY 2 BARREL
MODEL 4150

INCREASE AREA FROM .056 TO .072
BY DRILLING [CHECK DRILL CHART
FOR SIZE NEAREST CALCULATED NEW AREA]

TOLERANCES (EXCEPT AS NOTED)	REVISIONS			SOUTHEASTERN ILL COLLEGE		
DECIMAL ±	NO.	DATE	BY	MAIN JET MODIFICATION		
FRACTIONAL ±	1			DRAWN BY D. Rutledge	SCALE	MATERIAL
ANGULAR ±	2			CHK'D	DATE	DRAWING NO. 50
	3			TRACED	APP'D	
	4					
	5					



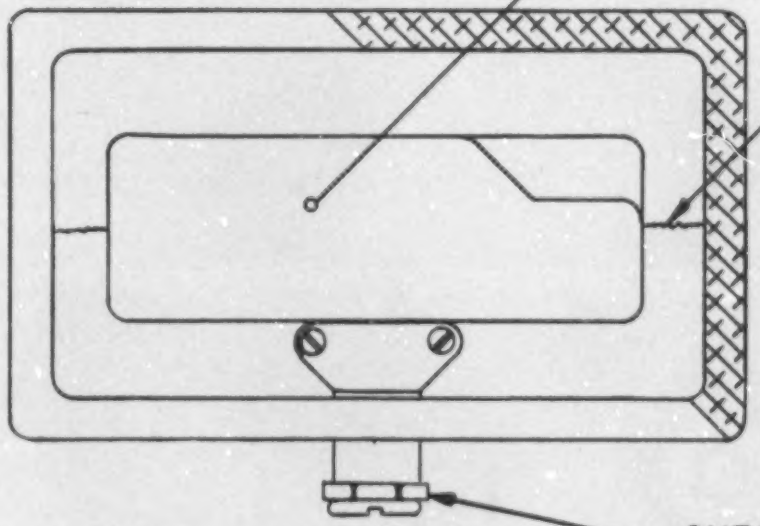
INCREASE ORIFICE BY DRILLING AT POSITIONS SHOWN

AREA TO BE ENLARGED BY 40 %

METERING BODY
HOLLEY CARBURETOR
MODEL 4150

TOLERANCES (EXCEPT AS NOTED)	REVISIONS			SOUTHEASTERN ILL COLLEGE		
DECIMAL ±	NO.	DATE	BY	METERING BODY MODIFICATION		
FRACTIONAL ±	1			DRAWN BY D. Rutledge	SCALE	MATERIAL
ANGULAR ±	2			CHK'D	DATE	DRAWING NO. 52
	3			TRACED	APP'D	
	4					
	5					

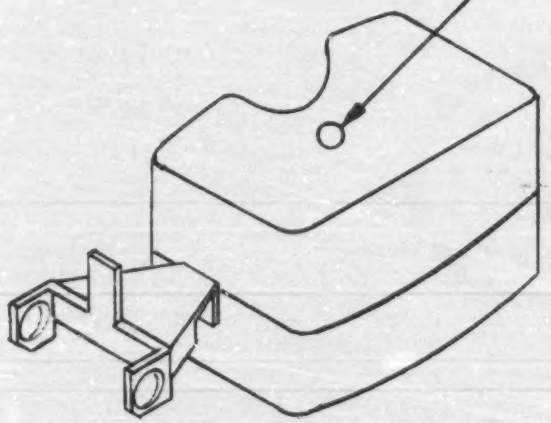
406-001-001



HOLLEY 2 BARREL
MODEL 4150

TOLERANCES (EXCEPT AS NOTED)	REVISIONS NO.	DATE	BY	SOUTHEASTERN ILL COLLEGE		
DECIMAL ±	1			FUEL LEVEL MODIFICATION		
FRACTIONAL ±	2			DRAWN BY D. Rutledge	SCALE	MATERIAL
ANGULAR ±	3			CHK'D	DATE	DRAWING NO. 54
	4			TRACED	APP'D	
	5					

406-002-001



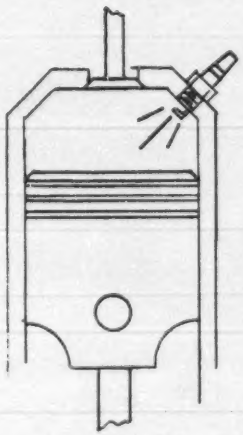
INCREASE WEIGHT BY 10 %.

BRASS FLOAT

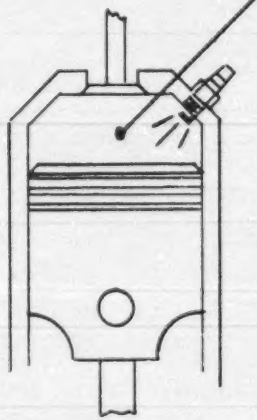
TOLERANCES (EXCEPT AS NOTED)	REVISIONS			SOUTHEASTERN ILLINOIS COLLEGE		
DECIMAL ±	NO.	DATE	BY	ROCHESTER CARB FLOAT		
FRACTIONAL ±	1			DRAWN BY D. Rutledge	SCALE	MATERIAL
ANGULAR ±	2			CHK'D	DATE	DRAWING NO. 56
	3			TRACED	APP'D	
	4					
	5					

500-001-002

COMPRESSION RATIOS: ALCOHOL-FUELED ENGINES HAVE MORE POWER DUE TO ADVANTAGE OF HIGHER COMPRESSION RATIO



8 TO 1



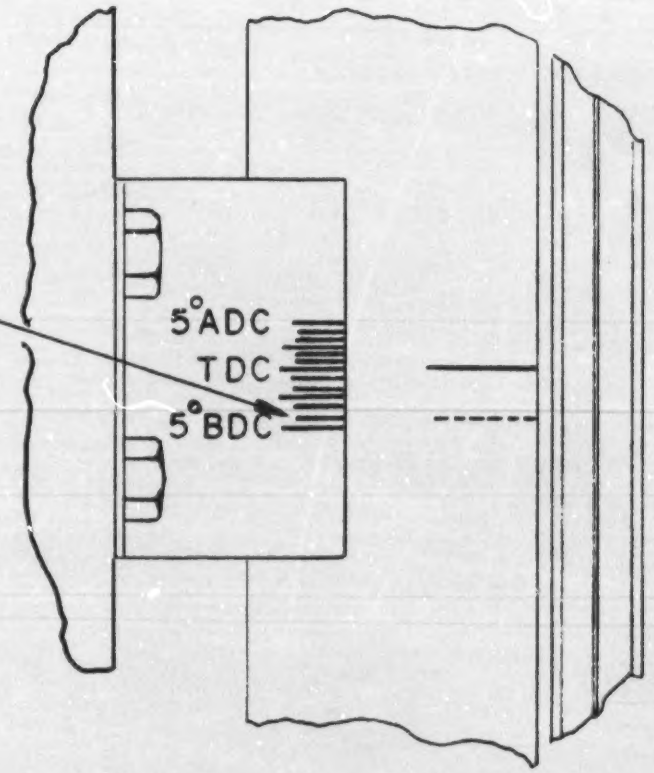
12 TO 1

AVAILABLE PUSH 16 TIMES GREATER THAN 8 TO 1 RATIO

TOLERANCES (EXCEPT AS NOTED)	REVISIONS			SOUTHEASTERN ILL COLLEGE		
DECIMAL ±	NO.	DATE	BY			
	1					
FRACTIONAL ±	2					
	3			DRAWN BY D. Rutledge	SCALE	MATERIAL
ANGULAR ±	4			CHK'D	DATE	DRAWING NO.
	5			TRACED	APP'D	

601-001-001

TIMING OF DISTRIBUTOR
ADVANCE AS SHOWN

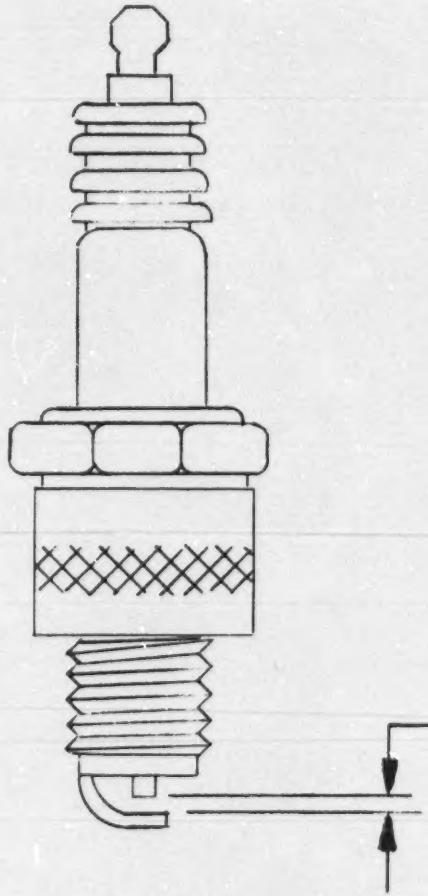


ADVANCE 4° AHEAD OF
MANUFACTURER'S SPECS

SHOWN FOR REFERENCE ONLY

TOLERANCES (EXCEPT AS NOTED)	REVISIONS			SOUTHEASTERN ILL COLLEGE		
	NO.	DATE	BY			
DECIMAL ±	1			TIMING MODIFICATION		
	2					
FRACTIONAL ±	3			DRAWN BY D. Rutledge	SCALE	MATERIAL
	4			CHK'D	DATE	DRAWING NO. 60
ANGULAR ±	5			TRACED	APV'D	

602-001-001



HOTTER PLUG REQUIRED
FOR ALCOHOL.

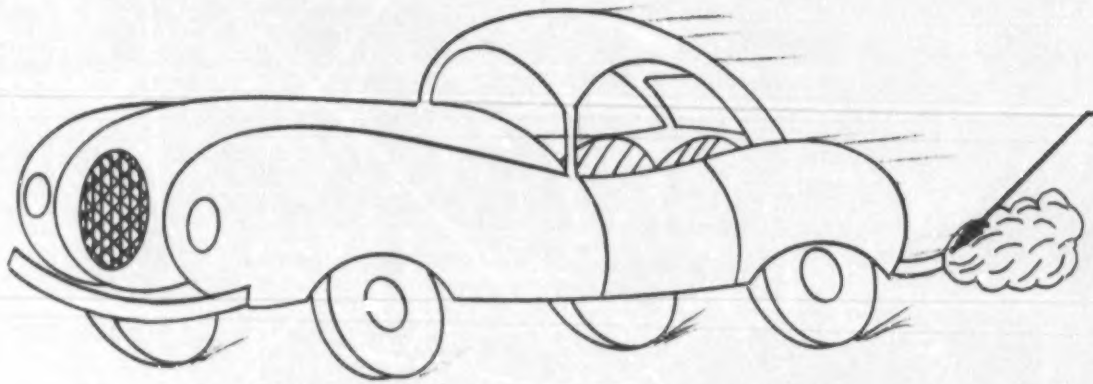
TOLERANCES (EXCEPT AS NOTED)	REVISIONS			SOUTHEASTERN ILL COLLEGE		
DECIMAL ±	NO.	DATE	BY			
	1			SPARK PLUG MODIFICATION		
FRACTIONAL ±	2					
	3			DRAWN BY D. Rutledge	SCALE	MATERIAL
ANGULAR ±	4			CHK'D	DATE	DRAWING NO.
	5			TRACED	APP'D	62

61

800-003-001

TESTING AND ANALYZING FOR EFFICIENCY

1. COMPUTE FUEL CONSUMPTION UNDER ROAD CONDITIONS (MPG)
2. ANALYZE ACCELERATION
3 ANALYZE IDLE PERFORMANCE
4 TEST STARTING PERFORMANCE



CHECK TEXT FOR PROCEDURE

TOLERANCES (EXCEPT AS NOTED)	REVISIONS			SOUTHEASTERN ILL COLLEGE		
DECIMAL ±	NO.	DATE	BY	PERFORMANCE ANALYSIS		
ANGULAR ±	1			DRAWN BY D. Rutledge	SCALE	MATERIAL
	2			CHK'D	DATE	DRAWING NO. 64
	3			TRACED	APP'D	
	4					
	5					